CX metrology plan for OAP optical components and assemblies

D. Content

September 19, 2002

Outline:

- metrology requirements
- Top level description of implementation for OAP
- Description of further work necessary for various potential flight designs

- Note: this is an update to the metrology plan presented at the Technology meeting 5/1/02

Metrology requirements have been documented and all are being met

frequency range or measurement type	range of period of errors sampled	equipment to be used	metrology requirement	estimated performance
shape, radius	shape only	Moore#3 CMM	0.3 um	0.2 um
roundness	few degrees - full	Moore#3 CMM	2.4 um	0.3 um
low frequency axial figure	5-200 mm	Wyko400 w/ 20cm Beam expander	0.1 um	0.013 um
high frequency axial figure or mid-frequency	1-30 mm	Bauer200 or Wyko400	5.5 nm	0.2 nm
microroughness	.002 - 1 mm	TOPO3D, Phase Shift MicroXAM	0.2 nm	0.1 nm

Note – Metrology requirement is typically 3x tighter than requirements on mandrels or reflectors

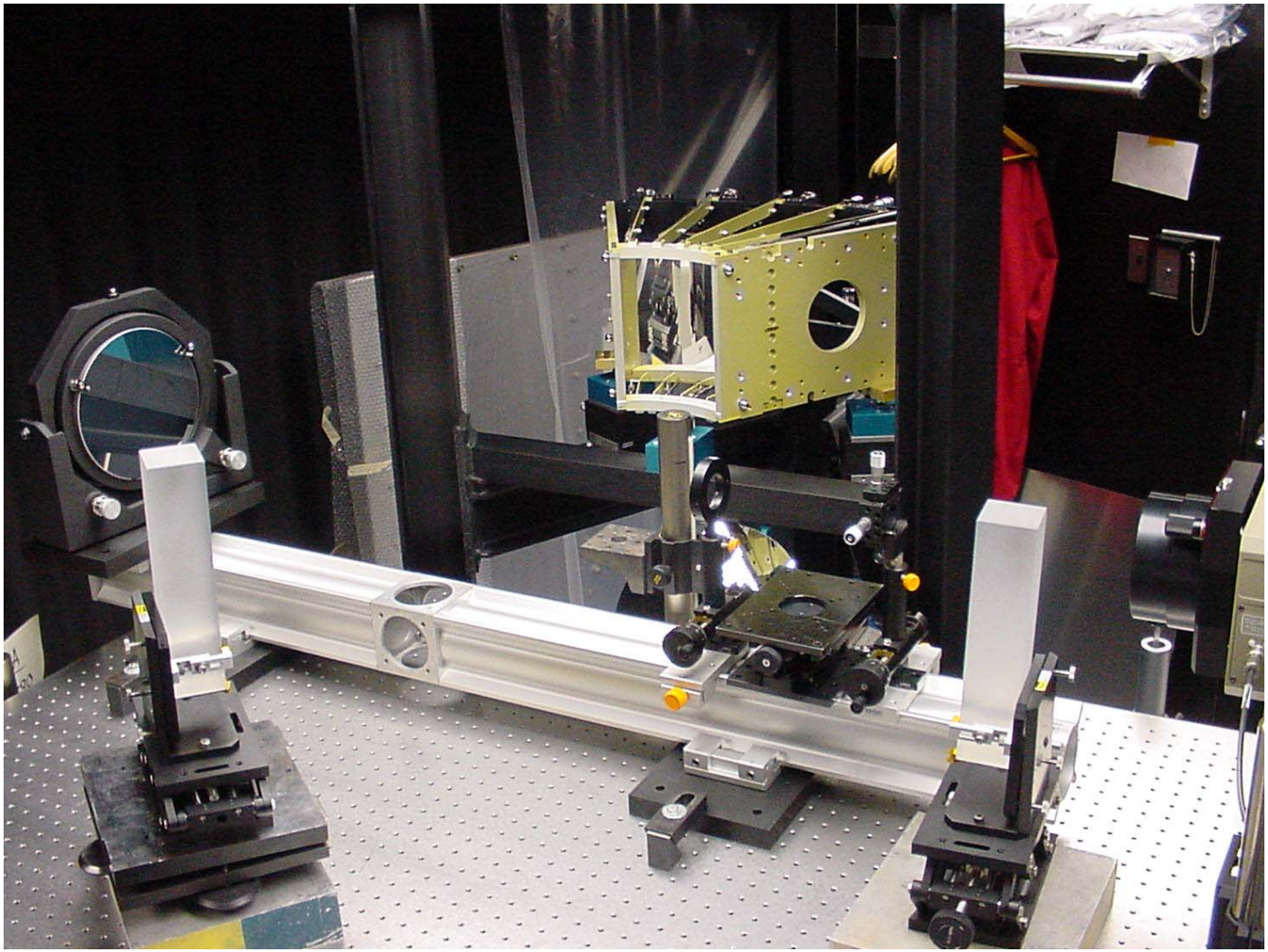
All required measurements are available now for mandrels up to the full OAP size of 20cm axial length by 50cm diameter; goal is ~ 1 day turnaround on critical measurements

Additional upgrades will be necessary to accommodate Zeiss P+H segmented mandrels

Axial figure station (1st of 2)

- Requirements
  - ~0.3 microns accuracy
  - 20 cm scan length, ~ 1 mm sampling (to overlap w/ Bauer midfrequency)
- to be implemented on foils, mandrels, and in-situ on OAP
- standard accuracy for direct measurements on these devices is usually quoted at ~ 0.003 micron rms level
  - basic concept is: f/3 reference lens on interferometer, aligned to an off-axis parabolic mirror w/ 20cm aperture -- produces 20cm (circular) collimated test beam, to be folded as necessary

Axial figure station - cont'd

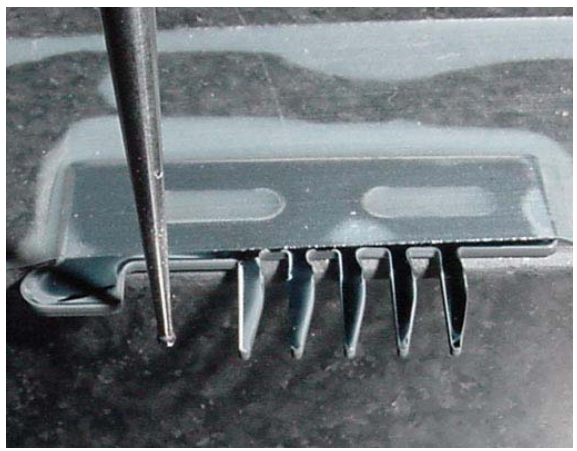


Wyko400 (w/ 20cm beam expander and fold flat) testing an OAP optic insitu

Moore#3 Coordinate measurement machine

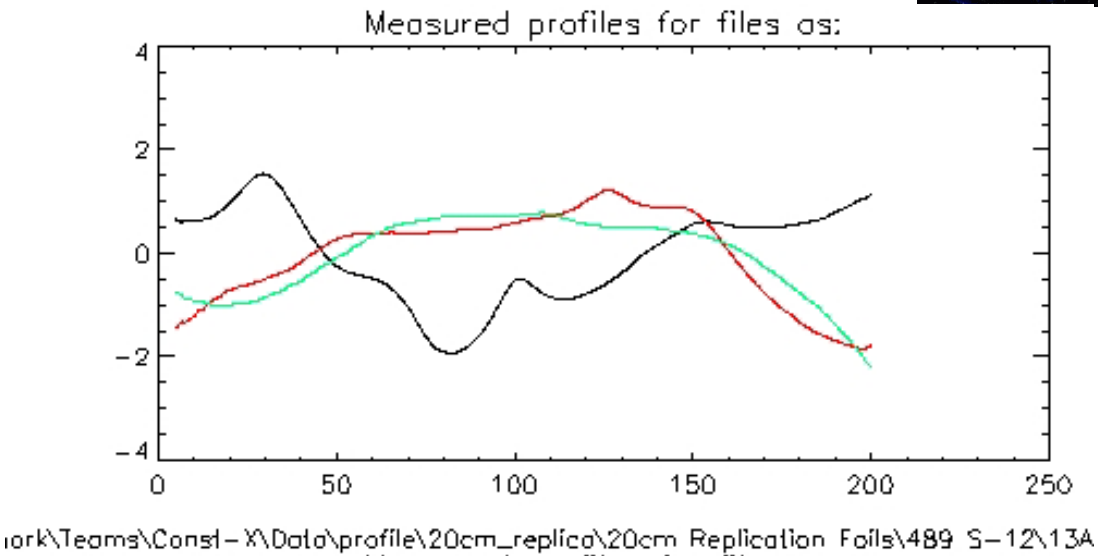
- Mechanical table with 3 axis interferometric position sensing
- Contact and non-contact probes
  - Non-contact probe being worked in now; will allow 3-D shape measurements
- ~225 mm longest axis of linear travel
- Rotation stages allow measurement of circularity using a fixed probe

MIT alignment comb with Moore probe

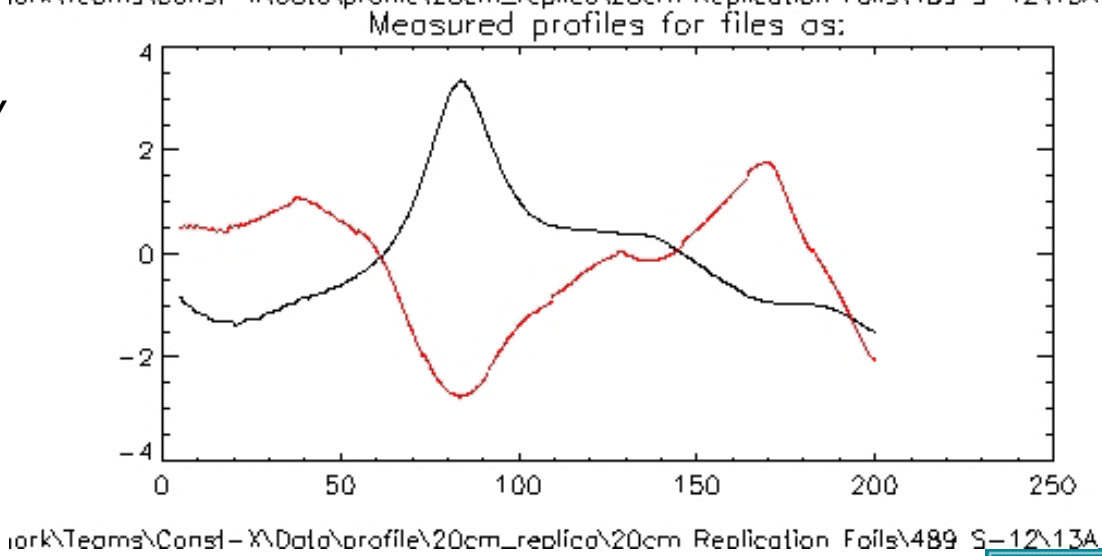


Example axial data – 489S-13

micron units	rms error w/ curvature removed	curvature coefficient
P1	0.5	6.7
P2	0.3	-7.6
P3	0.2	-6.8
P4	0.7	-8.8
P5	1.1	4.3

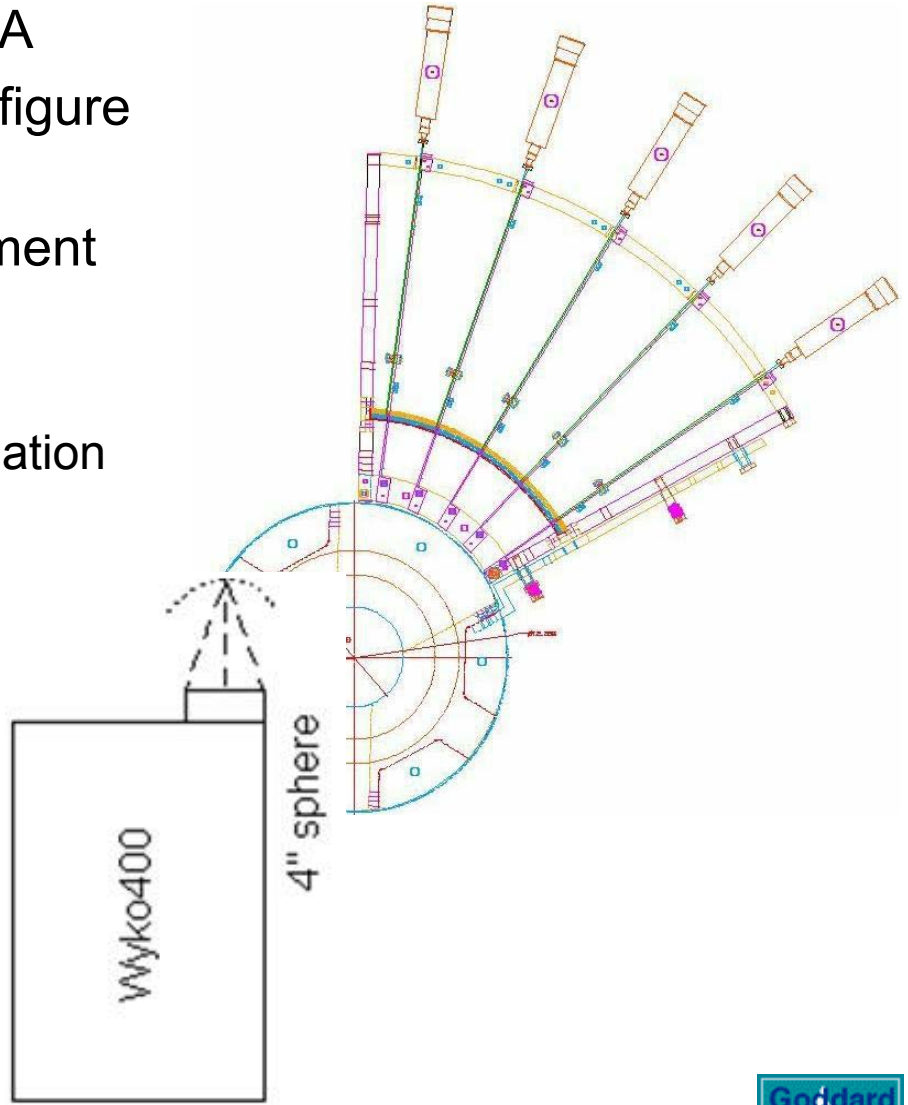


These represent early replication trials – currently improving replicated optic quality per W. Zhang's presentation



In situ metrology on OAP

- Wyko400 will complement the CDA
- Figure shows setup for azimuthal figure errors on OAP
- This will allow separation of alignment errors from intrinsic foil errors
  - CDA reports the sum of these
  - Gives additional diagnostic information



Upgrades for flight scale

As axial length grows beyond ~20 cm, the axial sag may exceed that measurable using plane wave interferometers

- Current capability is 20 cm
- We will be installing a 60cm plane wave interferometer in the reflector development facility in FY03
  - Will be usable for directly measuring conical forming mandrels
  - Should be able to use instead of VLTP for 20-30 cm Wolter-type replication or forming mandrels

- Current CMM may be too small, depending on exact configuration of mandrels

- Some hardware may be moved or replaced to allow crane access if measurements @ GSFC are required for >100 kg Zeiss replication mandrels